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Biotechnology: Cui Bono, Autem Cui Malo?

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SYMPOSIUM

ENGINEERING EDEN: INVESTIGATING THE LEGAL AND ETHICAL DILEMMAS OF MODERN BIOTECHNOLOGY

BIOTECHNOLOGY: *CUI BONO, AUTEM CUI MALO?*¹

DR. JOLYON JESTY*

Thank you very much. It is an honor, yet also scary, to be here. Teaching bioethics to medical students, and now to undergraduates, has been my hobby for about fifteen years.

* Professor of Medicine, Stony Brook University. These remarks are an actual transcript of the author's comments at the St. John's Journal of Legal Commentary Symposium on Feb. 25, 2005

¹ Translating as "To whom the benefit; but to whom the harm?" For a translation of the individual parts of the phrase, see *Latin Phrases*, <http://www.angelfire.com/empire/martiana/gens/LatinPhrases.html> (last visited Nov. 7, 2005). The slides that accompanied this presentation are available as a PDF file by e-mail request to the author (jolyon.jesty@sunysb.edu), or directly at <http://ms.cc.sunysb.edu/~jesty/sjlc.pdf> (last visited Nov. 7, 2005).

Thus, I think I have a good background, but I am pretty unqualified compared to the upcoming speakers. I think that my purpose here is to introduce the subject of "Engineering Eden," so I will begin the Symposium with a background discussion. I also want to raise some questions for you as I go along, and I expect, judging by the titles and backgrounds of the following speakers, that some of those questions may be answered by lunchtime.

The first thing to address is, "Who are bioethicists?" Wesley Smith pointed out the irony that even a hairdresser needs a license.² Bioethicists do not need licenses; in fact they can be complete amateurs, like me. Maybe there is a new program for St. John's here: Masters in Bioethics.

"Engineering Eden." Let us think about what this phrase means. I am a blood clotting person; it's my business. We blood clotting people, by the way, kill a lot of people in western countries. Although deaths from heart disease and stroke have fallen substantially in recent years, clotting problems of various sorts – chiefly heart attacks and strokes – still account for about forty percent of deaths in the United States.³

We also have experience of other serious diseases, and some are directly relevant to the perverse ethics of the American health system. Hemophilia A, for example, affects between one in five thousand and one in ten thousand males worldwide.⁴ For the most seriously afflicted, this disease was uniformly fatal until about the 1960's.⁵ Even now hemophilia causes major life-long problems, and is extremely expensive to treat. Adults with severe hemophilia will spend about two hundred thousand dollars per year on treatment if they want to have a functioning

² See WESLEY J. SMITH, *CULTURE OF DEATH: THE ASSAULT ON MEDICAL ETHICS IN AMERICA*, at x (Encounter Books, 2000); Sheryl Gay Stolberg, *Bioethicists Find Themselves the Ones Being Scrutinized*, N.Y. TIMES, Aug. 2, 2001, at A1.

³ See Robert N. Anderson & Betty Smith, *Deaths: Leading Causes for 2002*, NATIONAL VITAL STATISTICS REPORTS (Mar. 7, 2005), available at <http://www.cdc.gov/nchs/data/nvsr/nvsr53/nvsr5317.pdf>, 13-14 (stating that 29% of adult deaths in United States were caused by heart disease, and 7% from stroke). See generally *Blood Clots*, <http://www.drkoop.com/ency/93/001124.html> (last visited Sept. 19, 2005) (describing blood clots as "clumps that result from coagulation of the blood").

⁴ See Medline Plus, <http://www.nlm.nih.gov/medlineplus/ency/article/000538.htm> (last visited Sept. 19, 2005) (stating that Hemophilia A affects one in 5,000 men).

⁵ See *What is a Bleeding Disorder?*, http://www.hemophilia.org/bdi/bdi_history.htm (last visited Sept. 19, 2005) (articulating that discovery of clotting factors in 1960's led to saving of lives of hemophiliacs).

lifestyle.⁶ I am not talking about playing rugby; I am talking about getting up in the morning and going to work. Such treatment is far beyond the means of either individuals or most companies who might employ them. If a severe hemophiliac is insured in a small American company, they are liable to be fired because the insurance premiums of that company will get beyond the means of the people who run it.

Now I am going to go through some brief definitions. DNA, of course, is very much what we are going to talk about today. DNA is your history and your future. *Recombinant* DNA means taking a foreign gene, and inserting it into some other DNA. For instance, we might take an insecticidal gene from bacteria and insert it into maize (corn). That is recombination. For example, the human insulin gene is now expressed in bacteria in very large amounts, and all insulin for diabetic treatment comes out of a bacterium. It is a much better treatment than the old insulin, actually, which was pig insulin. My second example of recombinant DNA highlights some mistakes and dangers. Interleukin 4 is a mammalian protein, but if we insert the gene into the Mouse Pox virus, which is very closely related to Small Pox, we get an extraordinarily virulent version of Mouse Pox. This is really frightening. It was discovered by mistake in Australia a few years ago, and it was published.⁷ We must ponder whether such results should have been published. The publication is a detailed recipe for making something really dangerous and closely related to Small Pox.

What about some transgenic humans? What about a basketball gene? How about a height gene, also known as a growth hormone gene? More dunking. What about a cycling gene – more hemoglobin, so you can win the Tour de France seven years in a row? Or what about a TV presenter gene – more big hair? However, those examples are essentially facetious: let's start to consider the treatment of real disease.

⁶ See *Washington Days 2004 Position Paper: Access to Health Insurance* (2004), available at http://www.hemophilia.org/events/washingtonday_positionpapers_hi.htm (quoting yearly cost estimates for treatment ranging from \$150,000 to \$300,000 per year excluding complications).

⁷ See Ronald J. Jackson et al., *Expression of Mouse Interleukin-4 by a Recombinant Ectromelia Virus Suppresses Cytolytic Lymphocyte Responses and Overcomes Genetic Resistance to Mousepox*, 75 J. OF VIROLOGY 3, 1205, 1205-10 (Feb. 2001), available at http://www.pubmedcentral.nih.gov/article_render.fcgi?artid=114026 (discussing effects of modifying one virus).

First, we have the embryo stage. Imagine we have an embryo we would like to improve with a new gene. If we insert a gene into the early embryo, or into the egg it was formed from, that inserted gene will go into every cell of the organism, including the germ line cells, which will produce the eggs and the sperm of that organism in the future. The other name for that is "transgenic," and once the inserted gene is in the germ line cells, it is out in the big, wide world, if it is allowed to get out.

The other sort of introduction of DNA is more localized, and it goes into somatic cells. This is "gene therapy." That word "somatic" means any cell in your body *except* for eggs or sperm. Therefore, the somatic cells are not reproductive cells. They are regular body cells: liver, bone, and muscle, *et cetera*. So, when we insert a cell into somatic cells, as opposed to germ line cells, we are ensuring that the inserted cell is not going into future generations. In practice, gene therapy has come nowhere near being stable enough for one treatment even to last *one* generation.

Another term we need to think about is "clones." We are able to clone mice very easily now. There are many other clones, which we may define as organisms with identical DNA. Most bacteria are like that because they multiply by dividing. All we do is split the cell in half, and we now have two new cells. Some plants reproduce that way normally, and some human clones exist as well. For example, here are my identical twin daughters, about twenty years ago. They have identical DNA, but they underline the difference between simpler organisms and humans: they are completely different people. So, even though we might be able to control DNA exactly in the future, we do not necessarily know what we are going to get – as I myself know very well. My daughters are very nice people, but very different.

Now, let us go into games we can play with DNA and the genes within it; and I want to point out that this is not at all new. Old DNA engineering has been going on for a while: breeding. True breeding started around eight or ten thousand B.C.⁸ when people started forming small villages. They surely realized it was easier

⁸ Cf. Zach Zorich, *Origins of Farming Unearthed*, DISCOVER, Jan. 2005, at 13 (describing new anthropological finds that disturb settled principles that human breeding of farm animals began 11,000 years ago, and dating farming and breeding to 23,000 years ago).

to grow food and harvest it, and easier to control animals rather than run around the countryside trying to hunt them. From that date on, breeding has been the chief means of selection of traits. Breeding can be almost as powerful in the end as the modern methods, but limited for two reasons. Number one, breeding is very slow; and number two, the selection of the possible traits that you might want is really quite small. You cannot pick a gene out of a totally foreign species by breeding. You can only breed within a species, but I have one slide here to emphasize what sort of variation you can still get. Here are a Clydesdale and a Shetland pony. You can get much more spectacular breeding variation in dogs, of course, all the way from a Chihuahua to a Newfoundland, or in maize. Most of you probably know that maize started off in Mexico as a wild plant that bears almost no visible relation to the present varieties of corn.

Now, let us talk about therapies – because the whole purpose of this new “Eden” that this conference is about is the idea of making things better. Eden is supposed to be *perfection*, so I want to talk briefly about the earliest examples of therapeutics. Folk wisdom has circulated for thousands of years. In fact, in ten minute’s time, I will discuss a drug that has been known for several hundred years to be an effective treatment of a major disease. Folk wisdom is useful, but much of it is non-specific, and unproven. You go out to the so-called health food store, and you pick a bottle of whatever off the shelf, and often you just have to have faith that the bottled treatment is going to help you. Faith is actually pretty effective; in scientific terms, and this is called a placebo effect. Even if the compound does nothing, it is probably going to improve forty percent of the people who buy it.

I pick arbitrarily on 1747 as the first beautiful piece of science that I know of. The date might be slightly wrong. James Lind worked for the British Navy, went on a voyage or two, divided the crews into clearly defined groups, and fed those groups different things.⁹ The group of crewmen who almost instantly got their scurvy cured were the ones with lemons or limes in their

⁹ See *Historic Figures: James Lind (1716-1794)*, http://www.bbc.co.uk/history/historic_figures/lind_james.shtml (last visited Sept. 19, 2005) (relating historical account of Lind’s life and his contributions to curing scurvy).

diet, and that is why people like me who talk funny are called "limeys."

Very soon after, in 1774, we have the development of the small pox vaccine. This started with a theory that had been known for many hundreds of years: that Cow Pox protected against Small Pox.¹⁰ Everybody knew that milk maids had beautiful complexions, and that is where the notion began. The milk maids were always exposed to Cow Pox, and hence, they did not get Small Pox – and they were gorgeous. You may think I have got the wrong date, but actually 1774 is correct. This specific introduction of Cow Pox was done from a cow, and it was done not by Jenner, but by the brother of my great-great-great-great grandfather, a farmer. It is well-documented. If you want to look it up, research Benjamin Jesty. I will read his gravestone, because it is a little difficult to read. "He was born at Yetminster in this county." [Dorset, where Thomas Hardy was also from.] "He was an upright honest man." Of course. He was a Jesty, right?] "Particularly noted for having been the first person known to introduce the Cow Pox by inoculation, and who, from his great strength of mind, made the experiment from the cow on his wife and two sons." There is an ethical question for you: he didn't inoculate himself; but then he had already had Cow Pox. There was a paper in *Lancet* in December, 2003, about Benjamin's work.¹¹ But injecting his own wife and two sons - there is another important ethical question for you. The younger son was only two years old. Benjamin Jesty stuck a needle into a pock on the cow's udder, and did the inoculation similarly to the way vaccination is done: a scratch on the arm. His wife got very sick from his actions but all three survived. The two sons were later challenged with Small Pox, meaning that someone deliberately tried to infect them with Small Pox. His portrait was painted by the Vaccine Pock Institute, so he did have some official recognition.

¹⁰ See Alfred J. Sciarrino, *The Grapes of Wrath, Part II*, 8 MICH. ST. J. MED. & L. 1, 10-13 (2004) (discussing Dr. Edward Jenner's discovery of cow pox as an effective vaccination for Smallpox).

¹¹ See Patrick J. Pead, *Benjamin Jesty: New Light in the Dawn of Vaccination*, 362 LANCET 2104, 2104-09 (2003) (explaining experiments of Benjamin Jesty and recognizing him as the "first vaccinator").

So much for DNA and biology...what about engineering? John Snow, the father of epidemiology,¹² is, to my mind, the first bioengineer, but it is old-fashioned mechanical engineering. He was the first one to identify the water supply as being the source of cholera. John Snow and Benjamin Jesty together show that bioengineering is not all new magic; instead, it has been going on for some time. However, we must note that these examples are not part of this new "Engineered Eden."

Now, coming to modern times, we need to discuss 1953. Watson and Crick were *not* the people who proved DNA is the hereditary material; that was done in 1944 by a group led by Oswald Avery.¹³ Just seven years after that, Watson and Crick worked out the structure of DNA, and the structure was key to understanding how it works. This is because DNA and its structure include a means of copying DNA very faithfully.¹⁴ The DNA copying mechanism in eukaryotes, which is the upper life form of organisms with nuclei in their cells, is accurate to about one part in a hundred million. So, one base copying, roughly, will go wrong in every hundred million; this is extraordinarily accurate, particularly for a living thing. (The mistakes, of course, are what we call mutations, and are a fundamental part of the theory of natural selection.)

After Watson and Crick's discovery in 1953, the discoveries in the field of DNA came rapidly. The DNA code of base triplets was cracked in the 1960's. DNA was transferred between different organisms in the early 1970's; Paul Berg was the first to do that.¹⁵ Berg then called his moratorium, and brought together a national group to decide on rules and regulations about

¹² See Richard W. Clapp & David Ozonoff, *Environment & Health: Vital Intersection of Contested Territory?*, 30 AM. J. L. AND MED. 189, 189-90 (2004) (noting that origins of epidemiology are generally traced to Dr. John Snow and his water supply research).

¹³ See Dr. jur. Sandra Schmieder, *Scope of Biotechnology Inventions in the United States and in Europe – Compulsory Licensing, Experimental Use and Arbitration: A Study of Patentability of DNA-Related Inventions with Special Emphasis on the Establishment of an Arbitration Based Compulsory Licensing System*, 21 SANTA CLARA COMPUTER & HIGH TECH. L.J. 163, 167 (2004) (positing Oswald T. Avery's discovery of DNA's purpose as the "cornerstone for further ground-breaking inventions in biotechnology").

¹⁴ See David C. Hoffman, Note, *A Modest Proposal: Toward Improved Access to Biotechnology Research Tools by Implementing a Broad Experimental Use Exception*, 89 CORNELL L. REV. 993, 994 (2004) (indicating James Watson's and Francis Crick's solving of DNA's double helix structure "fundamentally transformed modern biology").

¹⁵ See Terri A. Jones, Note, *Patenting Transgenic Animals: When the Cat's Away, the Mice Will Play*, 17 VT. L. REV. 875, 879 (1993) (denoting Paul Berg's creation of recombinant DNA as launching point for modern genetic engineering).

recombinant DNA work. But just a few years later, in 1977, a human protein was produced in a bacterium: somatostatin.

Then we get to the crucial year of 1978. Louise Brown was the first test tube baby, using in-vitro fertilization techniques developed by Steptoe and Edwards.¹⁶ Yet, at that time, no one even raised the question about all the spare, unused, human embryos created via in-vitro fertilization. I do not know why. Of course, now those questions are being raised, but for some reason they were not raised then, and the quandary about what to do with them, or whether they may be "used", is still very much with us.

And now let's consider what this conference is really about – "Engineering Eden," referring to gene therapy, i.e. the introduction of a gene into a human (usually a functioning gene to replace a defective one). In 1990, the first gene therapy trial was performed on a child with a very simple immune disorder; the child lacked just one enzyme coded by one gene.¹⁷ That is the simplest situation that you can attack with gene therapy, with only one gene copy in your DNA. Furthermore, this child lacked the enzyme called adenosine deaminase; and with this particular enzyme, it does not matter whether the enzyme is expressed at high or low levels, as long as you have *some*. This means that there were no problems about controlling how much enzyme was expressed.

In the same year, 1990, as that first gene therapy trial for the child lacking the enzyme, we had the first transgenic cow. Now, this is in the germ line. We are talking about cows, or, more specifically, a race of cows that can produce a human protein in their milk. That is a very effective way of making recombinant protein; and with regard to the ethics and the risk, it is fortunate that cows weigh quite a lot, and they do not tend to trot around the countryside very much and get out. Therefore, we do not have to really worry much about those genes getting out into the wild cow population because there are no wild cows left anyway these days.

¹⁶ See *The Moral Case Against Cloning for Biomedical Research*, 18 ISSUES L. & MED. 261, 267 (2003) (attributing birth of test-tube baby Louise Brown to Dr. Patrick Steptoe and Dr. Robert Edwards).

¹⁷ See Wilder J. Leavitt, Note, *Regulating Human Gene Therapy: Legislative Overreaction to Human Subject Protection Failures*, 53 ADMIN. L. REV. 315, 321–22 (2001) (explaining first gene therapy trial, performed in 1990).

But what about genes that can get out into the wild world? In 1992, we have a worrying event – well, to me, it is worrying. You do get a few personal opinions in this point. The FDA¹⁸ decided that transgenic food is *not* inherently dangerous.¹⁹ However, the FDA made a very narrow statement referring to lack of any direct toxic effects to humans from eating food made from transgenic animals or produce. So, if you eat transgenic corn, which you probably do, or if you eat transgenic tomatoes, which you almost certainly do these days, you are not going to get sick from eating those crops. What the FDA did *not* address – and what the FDA has no authority to address – is whether those transgenic genes might get out into the wild population and what damage that might do. Mexico, in particular, is extremely worried about the genes in Monsanto's herbicide-resistant maize, because that transgenic corn has already got down to Mexico, its "transgenes" mixing with the wild, earlier population of maize.

Moving on In 1997, scientists in Scotland cloned Dolly, the sheep. There were many failures involved in that experiment, and there were many failures before Dolly was born. Moving on further towards the present, in the year 2000, researchers completed the draft sequence of the human genome. That is your entire DNA sequence; however, for a lot of that sequence, the function is not described.

In 2001, we come to probably the first problem of "Engineering Eden." Well, maybe the transgenic crop problem was the *first* problem, but the year 2001 is the date of the first *human* problem. Ten French children with an immune disease, where each lacked one specific protein, which was actually different from the one I just talked about, were initially cured by gene therapy using a virus vector. (*Vector*: the virus, complete with an inserted copy of the human gene and other pieces of DNA that control its expression, carries the gene into the body's cells.) Later, two of the ten children got leukemia caused by the virus vector. These were retro-viruses, and they are a rather nasty type of virus. They tend to plop down in DNA where they are not

¹⁸ U.S. Food and Drug Administration, <http://www.fda.gov/> (last visited Sept. 19, 2005).

¹⁹ See John Charles Kunich, *Mother Frankenstein, Doctor Nature, and the Environmental Law of Genetic Engineering*, 74 S. CAL. L. REV. 807, 843 (2001) (explicating FDA's position on safety of genetically modified foods).

wanted, and turn on cancer-causing genes. That means cell growth goes out of control - which is what leukemia and other cancers are. So, that was the first - but it certainly will not be the last - instance of gene therapy gone awry.

In 2001, and I think this is the end of my history list, we have the first deliberate production of human embryos *not for reproduction*. A private in-vitro fertilization center in Virginia made human embryos specifically for *destruction*.²⁰ These embryos were not created for implantation into women to make babies. The purpose of that mixing of egg and sperm was to make human embryonic stem cells, and the purpose of *that* was to start playing around with human embryonic material in the lab. These acts were perfectly legal both in Virginia and in the United States then, and they are *still* legal today in 2005.²¹ Brave New World, 2001, with the first deliberate destruction of human embryos for scientific purposes.

Now, what about regulations? Having discussed the history of "Engineering Eden," let us talk about the regulations involved. I hope you will get the idea that regulations, in the United States in particular, are an absolute mess. In the 1970's, Paul Berg looked at the risks involved in recombinant DNA in bacteria; but there was no problem there, and people work with that all of the time, and it is perfectly safe. But in the 1970's, there were absolutely no regulations about generation of human embryos.

In the 1980's, there were no regulations about transgenic crops or animals until they become *food* - until you pop them into your mouth. So, for instance, I read in the paper just recently that you will very soon be able to buy fluorescent zebra fish in pet stores; that fluorescent gene is now permanently into the germ line of these modified zebra fish, and zebra fish multiply like crazy. So you can expect that the wild population of zebra fish is

²⁰ See Sina A. Muscati, *Defining a New Ethical Standard for Human In Vitro Embryos in the Context of Stem Cell Research*, 2002 DUKE L. & TECH. REV. 26, 34 (2002) (noting how Jones Institute for Reproductive Medicine at the Eastern Virginia Medical School was first to produce human embryos solely in order to harvest stem cells).

²¹ See VA. CODE ANN. § 2.2-2233.2 (West 2005) (prohibiting use of funds from the State Biotechnology Commercialization Loan Fund for human embryonic stem cell research but not prohibiting private funding of such research); Steven Goldberg, *Cloning Matters: How Lawrence v. Texas Protects Therapeutic Research*, 4 YALE J. HEALTH POL'Y L. & ETHICS 305, 313 (2004) (emphasizing that President Bush's 2001 prohibition on using federal funds for embryonic research permits such research to continue, so long as it is privately funded).

going to include some fluorescent ones pretty soon. There were no regulations about that, either, and that is still true.

Now, many of my students, my undergrads in particular, think that President Bush banned work on embryonic stem cells. He did not. Working on embryonic stem cells is still perfectly legal in the United States; however, Bush did ban the use of federal funds for such research.²² This might be called a wrong-headed decision, because there are still no regulations about other people who are not using federal money performing research on human embryonic stem cells. Furthermore, there is still no federal law against reproductive cloning, which means the production of cloned embryos for implantation and birth. Such embryos can be genetically modified before implantation into a uterus and the development of a baby, and that is still legal.²³

In 2004, human embryos were finally cloned by Dr. Hwang in Korea and were implantable at that stage. He could have started trying to modify the embryos, and he could have implanted them in utero. Mind you, he had to go through about two hundred and eighty human eggs from volunteer women, who had donated their eggs, to get just a handful of cloned embryos. However, regardless of the low success rate, this shows that the possibility is right there. There is absolutely nothing to stop me settling in any number of states in the United States – a majority of states, actually – and cloning human embryos. Somebody gives me some money, and then I can find a source of discarded embryos from IVF centers where I can start cloning. Nobody can take me to court for that yet.

I think there is a better way, and Britain is an example. Back in 1991, fifteen years ago, way before Dolly, the British government decided to form a formal authority, called the Human Fertilization and Embryology Authority.²⁴

²² See Goldberg, *supra* note 21, at 313 (highlighting said prohibition permits such research to continue “so long as” it is privately funded) (emphasis added).

²³ Although many bills have been introduced in Congress that include such a ban, none has reached the President’s desk. In contrast, a number of States, about ten in 2005, not including New York, have bans on reproductive cloning. See National Conference of State Legislatures, *State Human Cloning Laws* (June 21, 2005), <http://www.ncsl.org/programs/health/genetics/rt-shcl.htm>.

²⁴ See Human Fertilization and Embryology Authority, <http://www.hfea.gov.uk/Home> (last visited Sept. 19, 2005) (describing itself as “a non-departmental Government body that regulates and inspects all UK clinics providing IVF, donor insemination or storage of eggs, sperm or embryos”).

Despite Britain having a highly regulated environment, stem cell research in Britain is much further advanced than in the United States. Everybody knows the rules; the rules are quite clear. You are allowed to do this and that, with authorization, but you are not allowed to do reproductive cloning. A large majority of British people are pleased about embryonic-stem-cell research for therapeutic purposes, and they are also pleased about their country's effective regulations.

From the problems of regulating embryos and cloning, let me move on to drug regulation and some of its ethical problems. The FDA requires that drugs be safe,²⁵ whatever that means. Drugs must also be effective. But what does "effective" mean? It means generally that the new drug must be *more effective than nothing*. That second requirement is a serious problem because it means that neither patients nor doctors can really compare drugs with each other, since the trial process for drugs involves comparing a drug with a placebo.²⁶ The fact is that manufacturers are not expected to compare their product with an *existing* product. Only when something major happens do comparisons between existing drug products get done, and then usually by the government. The hypertension market, for example, is a fifteen-billion-dollar drug market.²⁷ The majority of that money buys fancy, newer drugs. I will not tell you the details, but they are just ordinary stuff that your doctor is going to prescribe for you. However, for just one patient these drugs are going to cost you or your insurance company about three to five hundred dollars a year. In 2002 the NIH²⁸ funded a study to compare these new expensive classes of hypertension drugs with the old, cheaper, treatment of water pills, i.e. diuretics. NIH found that diuretics are more

²⁵ See 21 U.S.C.S. § 355(d) (Law. Co-Op. 2005) (empowering FDA to refuse a new drug application if drug is found unsafe for use).

²⁶ See 21 C.F.R. § 314.126(b)(2)(i) (2005) (describing characteristics of an adequate and well-controlled study that supports effectiveness of a new drug as including a placebo-controlled element).

²⁷ See generally *Medicure Announces First Quarter Financial Results*, CAN. CORP. NEWSWIRE, Oct. 14, 2004 (noting "[t]he cardiovascular market is the largest pharmaceutical sector with annual global sales of over US \$70 billion").

²⁸ See Scott Davison, Article, *Influencing NIH Policy over Embryonic Stem-Cell Research: An Administrative Tug-of-War between Congress and the President*, 22 J. NAALJ 405, 409 (2002) (explaining that National Institutes of Health is an administrative agency within Department of Health and Human Services that "creates standards for organizations to obtain federal funding for many types of biomedical research").

effective than *all or any* of the new drug classes in controlling hypertension. So, all those new drugs were licensed because they are better than nothing. They were not compared with the old, previous treatments until the NIH spent a lot of money on this study. And still doctors prescribe the new expensive ones.

Such studies also bring up a thorny ethical question. If a treatment exists, and you develop a new drug, then you do a trial on patients. If I am a patient in the control group receiving a placebo, I am then getting treatment which is poorer than the current standard or available treatment. That came out a little confused, but I hope you get the message. So, where there is an existing treatment, is it right to do your standard drug trial where the control group is actually getting treated with nothing? I am not going to answer that question. Think about it.

The next question we must address, is "Who are drug consumers?" Doctors write prescriptions. Most consumers either do not pay at all, or pay a flat deductible. Occasionally, there will be consumers who actually have to pay cash for their drugs, but still it is the doctor deciding. Until recently, that included people on Medicare, but they are not in the majority. None of those people, neither the doctors nor the majority of patients, have an interest in the price of that drug. So, insurance companies actually pay the cost.

To illustrate my point, let us examine advertisements from a recent New York Times.²⁹ These ads, actually, happen to be full-page ads right opposite each other. The left-hand one is a standard ad for a T-Mobile® phone service, and the right-hand one is what I call a "hard on" prescription pill for erectile dysfunction. There is a disconnect between these two ads. The advertisement on the left is an ordinary ad: it is all about cost and value. The advertisement on the right has absolutely nothing about *cost* in it. Imagine being able to advertise something with *no information about cost*. It tells you that the market for that product, Cialis®, is so totally screwed up that the consumers have no interest in cost. I am not sure how to fix this problem. I just wonder who benefits.

²⁹ See generally Simon King, *Eli Lilly Launches Bullish Marketing Campaign for ED Treatment Cialis*, WORLD MARKETS ANAL., July 13, 2004 (noting full page advertisements in major news publications supporting "Cialis Promise" campaign).

For my final point, I want to tell you a tale of two drugs. The left-hand drug is difficult to make, and is a rare natural product. It came from folk wisdom, as I referred to earlier, known for hundreds of years, although the structure of the drug was not known until recently. The advertising budget is nothing. Certain drug companies were interested in this drug for some time, but decided it was not in their financial interest, despite there being five hundred million people in the world infected with a disease that this drug treats, and very effectively too. There are between one and two million deaths per year from that disease, mostly children.

Now, for the other drug, have a look at the right. This prescription drug is easy and cheap to make. The advertising budget in the United States is more than a hundred million dollars per year, and the revenue is approximately one billion per year. That figure was from last year, so by now the revenue is probably about \$1.2 billion. As far as medical benefits go, this drug has saved no lives; the benefit is mainly emotional.

So what are these in my tale of two drugs? The first drug I described, the one on the left, as you probably guessed, is a malaria drug, called Artemisinin, derived from a Chinese shrub. The drug on the right is Viagra.

Thank you very much.